

RESIN COMPOSITION FOR CAPSTOCK

a' > BACKGROUND OF THE INVENTION

The present invention relates to a resin composition for  
5 capstock containing an impact modifier having a multilayer structure as  
a main component, and more particularly to an acrylic resin  
composition suitable for producing capstock having excellent impact  
resistance, weatherability and processability and a low gloss by using a  
multi-manifold die.

10 It is well known that acrylic resins are excellent in  
weatherability. By utilizing this feature, acrylic resins have been used  
as a capstock for materials which require a weatherability. For example,  
U.S. Patent No. 4,198,520 discloses improving the weatherability of  
materials having a poor weatherability such as ABS resin and PVC by  
15 applying an acrylic resin as a capstock to the surface of the materials.  
Further, U.S. Patent No. 5,318,737 and WO 00/08098 disclose that an  
acrylic resin composition suitable for the production of capstock having  
excellent weatherability and impact resistance is obtained by adding a  
rubber component to an acrylic resin.

20 Although these products have been used in the market,  
however, it is hard to say that they sufficiently meet demands of the  
market in a field which requires a low gloss, since they have a high gloss  
peculiar to acrylic resins.

As a method of lowering the gloss are known addition of an  
25 inorganic material such as silica or talc, addition of a styrenic block  
copolymer such as SBS (styrene-butadiene-styrene block copolymer),  
SB (styrene-butadiene block copolymer), SEBS (styrene-ethylene-

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butylene-styrene block copolymer) or SIS (styrene-isoprene-styrene block copolymer), addition of an olefin rubber such as EPR (ethylene-propylene rubber) or EPDM (ethylene-propylene-diene rubber), addition of NBR (nitrile rubber), and the like. However, the addition of these  
5 materials is unfavorable because of bringing about lowering of impact resistance or weatherability, although the gloss is reduced thereby.

Also, with respect to the processing method, coextrusion using feed block die is disclosed, for example, in U.S. Patent No. 5,318,737. Since the viscosity of respective layers must be matched  
10 with each other, the melt characteristics of acrylic resin compositions are restricted, and the U.S. patent discloses that MFI (melt flow index) must be from 0.4 to 0.75 g/10 minutes. WO 00/08098 does not limit the processing method, but discloses that MFI is not less than 1.5 g/10 minutes for obtaining good products. However, if MFI is not less than  
15 0.4 g/10 minutes, the obtained products have a high gloss and, therefore, are not applicable to uses requiring a low gloss. That is to say, it is required for obtaining low gloss products to increase the viscosity, but resins having an MFI of not more than 0.35 g/10 minutes are not processed to give good products by coextrusion using a feed  
20 block die which has been popularly used. Thus, it is difficult to achieve an excellent processability and a low gloss together.

Like this, it is very difficult to stably produce products having a low gloss and a beautiful surface with the impact resistance being maintained. It is the actual situation that there has not been provided  
25 a capstock made of an acrylic resin as a main component having impact resistance, weatherability, processability and low gloss that can sufficiently satisfy the demands of the market.

It is an object of the present invention to solve the problems mentioned above and to provide a capstock having excellent impact resistance, weatherability and processability and a low gloss which cannot be achieved by conventional acrylic resins.

5 A further object of the present invention is to provide an acrylic resin composition having an excellent processability suitable for the production of low gloss capstock.

#### SUMMARY OF THE INVENTION

10 The present inventors have found that an acrylic resin composition having an MFI (melt flow index) of not more than 0.35 g/10 minutes and comprising a multilayer structure polymer having a very high viscosity and a very high elasticity, which can serve as an impact modifier, and optionally a methyl methacrylate copolymer has an  
15 excellent processability and can provide a capstock having excellent impact resistance and weatherability and a low gloss by coextrusion using a multi-manifold die

Thus, the present invention provides:

(1) a resin composition suitable for extrusion to prepare a  
20 capstock using a multi-manifold die comprising (a) 100 to 30 parts by weight of an impact modifier having a multilayer structure and (b) 0 to 70 parts by weight of a methyl methacrylate polymer comprising 50 to 100 % by weight of methyl methacrylate and 50 to 0 % by weight of a copolymerizable monomer, the total of said impact modifier (a) and said  
25 methyl methacrylate polymer (b) being 100 parts by weight and said composition having an MFI (melt flow index measured according to ASTM D-1238 at 230°C and a load of 3.8 kg) of not more than 0.35 g/10

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minutes;

(2) the composition of item (1), which comprises 80 to 40 parts by weight of said impact modifier (a) and 20 to 60 parts by weight of said methyl methacrylate polymer (b), the total of (a) and (b) being 100  
5 parts by weight;

(3) the composition of item (1), wherein said methyl methacrylate polymer comprises 5 to 90 % by weight of a methyl methacrylate polymer having a molecular weight of not less than 500,000 and 95 to 10 % by weight of a methyl methacrylate polymer  
10 having a molecular weight of less than 500,000;

(4) the composition of item (1), wherein said impact modifier is a polymer having two layer structure prepared by polymerizing 80 to 15 parts by weight of a monomer mixture comprising 50 to 100 % by weight of a (meth)acrylic ester and 50 to 0 % by weight of a  
15 copolymerizable monomer in the presence of 20 to 85 parts by weight of a crosslinked acrylic rubber;

(5) the composition of item (1), wherein said impact modifier is a polymer having three layer structure prepared by polymerizing 30 to 60 parts by weight of a monomer mixture comprising 50 to 99.9 % by weight of an alkyl acrylate, 50 to 0 % by weight of a copolymerizable monomer and 0.1 to 5 % by weight of a crosslinking monomer in the presence of 10 to 40 parts by weight of a polymer prepared by polymerization of 80 to 99.9 % by weight of methyl methacrylate, 20 to 0 % by weight of a copolymerizable monomer and 0.1 to 5 % by weight of  
25 a crosslinking monomer to give a two-layered polymer, and then polymerizing 10 to 60 parts by weight of a monomer mixture comprising 50 to 100 % by weight of a (meth)acrylic ester and 50 to 0 % by weight of

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a copolymerizable monomer in the presence of said two-layered polymer;

(6) the composition of item (1), wherein said capstock is a capstock for a siding panel made of polyvinyl chloride;

5 (7) a molded article comprising a substrate made of a thermoplastic resin and a capstock layer made of the resin composition of item (1) and provided on at least one surface of said substrate; and

(8) a siding panel obtained by extrusion using the composition of item (1) as a capstock and a vinyl chloride resin as a substrate.

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#### DETAILED DESCRIPTION

The acrylic resin composition of the present invention comprises 0 to 70 parts (parts by weight, hereinafter the same) of a methyl methacrylate polymer comprising 50 to 100 % (% by weight, hereinafter the same) of methyl methacrylate and 50 to 0 % of a copolymerizable monomer and 100 to 30 parts of an impact modifier having a multilayer structure (the total being 100 parts), and the composition has an MFI (melt flow index measured according to ASTM D-1238 at 230°C and a load of 3.8 kg) of not more than 0.35 g/10

15 minutes, preferably not more than 0.2 g/10 minutes. The acrylic resin composition is suitable for the production of capstocks by extrusion using a multi-manifold die.

The methyl methacrylate polymer includes homopolymer and copolymers obtained by polymerization of 50 to 100 % of methyl 25 methacrylate and 50 to 0 % of other monomer copolymerizable therewith. If the amount of methyl methacrylate is less than 50 %, the effect of improving the weatherability of capstock moldings is insufficient. The

content of methyl methacrylate in the polymer is preferably from 60 to 98 %, more preferably from 75 to 95 %, from the viewpoints of weatherability and surface hardness. The other monomers copolymerizable with methyl methacrylate include, for instance,  
5 aromatic vinyl compounds, acrylic esters, methacrylic esters other than methyl methacrylate, vinyl cyanide compounds such as acrylonitrile and methacrylonitrile,  $\alpha,\beta$ -unsaturated carboxylic acids such as (meth)acrylic acid and crotonic acid, vinyl acetate, olefins such as ethylene and propylene, halogenated vinyl monomers such as vinyl  
10 chloride and vinylidene chloride, maleimide compounds such as N-alkylmaleimides, and other vinyl compounds.

Examples of the aromatic vinyl compounds are, for instance, styrene, o-methylstyrene, m-methylstyrene, p-methylstyrene,  $\alpha$ -methylstyrene, chlorostyrene and other styrene derivatives.

15 Examples of the acrylic esters are, for instance, an alkyl acrylate having a C<sub>1</sub> to C<sub>8</sub> alkyl group such as ethyl acrylate, butyl acrylate, n-octyl acrylate or 2-ethylhexyl acrylate, cyclohexyl acrylate, isobornyl acrylate, phenyl acrylate, benzyl acrylate, and the like.

20 Examples of the methacrylic esters are, for instance, an alkyl methacrylate having a C<sub>2</sub> to C<sub>8</sub> alkyl group such as ethyl methacrylate, butyl methacrylate, n-octyl methacrylate or 2-ethylhexyl methacrylate, cyclohexyl methacrylate, isobornyl methacrylate, phenyl methacrylate, benzyl methacrylate, and the like.

25 These copolymerizable monomers may be used alone or in admixture thereof.

The methyl methacrylate polymer can be prepared by emulsion polymerization, suspension polymerization, bulk

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polymerization, solution polymerization and so on. Of these, bulk polymerization is particularly preferred from the viewpoint of decreasing the content of impurity in the polymer.

The impact modifier having a multilayer structure is a  
5 polymer having a multilayer structure obtained by polymerizing a vinyl monomer in a single stage or in two or more stages in the presence of particles of a rubbery polymer. The rubbery polymer includes, for instance, an acrylic rubber, a diene rubber, a silicone rubber and the like. Examples of the diene rubber are, for instance, polybutadiene  
10 rubber, isoprene rubber, SBR, NBR, and the like. Examples of the acrylic rubber are, for instance, butyl acrylate-based rubber, n-octyl acrylate-based rubber, 2-ethylhexyl acrylate-based rubber, and the like. Of these, acrylic rubbers are preferred from the viewpoint that the weatherability of obtained capstocks is not lowered.

15 In general, these rubbers are used in the form of crosslinked rubber. Any of compounds known as crosslinking monomer or crosslinking agent are used as a compound for forming a crosslinked structure. Preferable examples thereof are allyl methacrylate, allyl acrylate, diallyl maleate, diallyl fumarate, diallyl itaconate, monoallyl  
20 maleate, butadiene, divinyl benzene, and the like. These may be used alone or in admixture thereof.

The crosslinked rubber particles may further contain a hard polymer in the inner layer as a core of the particle. The ratio of the hard core to the rubber layer (core/rubber layer) is usually from 10/90 to  
25 60/40 by weight.

The crosslinked acrylic rubbers are obtained, for example, by polymerizing a monomer mixture of 50 to 99.9 %, preferably 70 to 99 %,

of an alkyl acrylate having a C<sub>4</sub> to C<sub>8</sub> alkyl group, 50 to 0 %, preferably 30 to 0 %, of a copolymerizable monomer and 0.1 to 5 % of a crosslinking monomer. Examples of the monomer copolymerizable with the alkyl acrylate are, for instance, alkyl acrylates having a C<sub>1</sub> to C<sub>3</sub> alkyl group,  
5 aromatic vinyl compounds such as styrene, o-methylstyrene, m-methylstyrene, p-methylstyrene,  $\alpha$ -methylstyrene, chlorostyrene and other styrene derivatives, alkyl methacrylates having a C<sub>1</sub> to C<sub>8</sub> alkyl group such as methyl methacrylate and ethyl methacrylate, other methacrylic esters such as cyclohexyl methacrylate, isobornyl  
10 methacrylate, phenyl methacrylate and benzyl methacrylate, vinyl cyanide compounds such as acrylonitrile, vinyl acetate,  $\alpha,\beta$ -unsaturated carboxylic acids such as (meth)acrylic acid and crotonic acid, olefins such as ethylene and propylene, halogenated vinyl monomers such as vinyl chloride and vinylidene chloride, maleimide compounds such as  
15 N-alkylmaleimides, and other vinyl compounds. These monomers may be used alone or in admixture thereof.

In case of forming a hard core as an inner layer of the crosslinked acrylic rubber, the above-mentioned monomer mixture is polymerized preferably in the presence of a hard polymer obtained by a  
20 polymerization, preferably emulsion polymerization, of a monomer mixture of 40 to 99.9 %, preferably 80 to 99.9 %, of methyl methacrylate, 0 to 60 %, preferably 0 to 20 %, of other copolymerizable monomer and 0.1 to 5 % of a crosslinking monomer. Examples of the other copolymerizable monomer used in the preparation of the hard polymer  
25 are alkyl (meth)acrylates other than methyl methacrylate such as alkyl (meth)acrylates having a C<sub>1</sub> to C<sub>8</sub> alkyl group, other (meth)acrylic esters such as cyclohexyl methacrylate, isobornyl methacrylate, phenyl

methacrylate and benzyl methacrylate, aromatic vinyl compounds such as styrene, o-methylstyrene, m-methylstyrene, p-methylstyrene,  $\alpha$ -methylstyrene, chlorostyrene and other styrene derivatives, vinyl cyanide compounds, vinyl acetate,  $\alpha,\beta$ -unsaturated carboxylic acids such as (meth)acrylic acid and crotonic acid, olefins such as ethylene and propylene, halogenated vinyl monomers such as vinyl chloride and vinylidene chloride, maleimide compounds such as N-alkylmaleimides, and other vinyl compounds. These monomers may be used alone or in admixture thereof.

In general, the impact modifier having a multilayer structure is obtained by polymerizing 10 to 80 %, preferably 10 to 70 %, of a vinyl monomer in a single stage or in two or more stages in the presence of 90 to 20 %, preferably 90 to 30 %, of crosslinked rubber particles (the total of the vinyl monomer and the rubber particles being 100 %). The content of the crosslinked rubber particles in the obtained multi-layered polymer is from 20 to 90 %, preferably from 30 to 90 %, more preferably from 50 to 85 %, the most preferably from 60 to 80 %, from the viewpoints of moldability and weatherability.

Examples of the vinyl monomer to be polymerized in the presence of the rubber polymer particles are, for instance, an alkyl methacrylate such as methyl methacrylate or ethyl methacrylate, preferably an alkyl methacrylate having a C<sub>1</sub> to C<sub>4</sub> alkyl group, an alkyl acrylate, e.g., an alkyl acrylate having a C<sub>1</sub> to C<sub>8</sub> alkyl group such as methyl acrylate, ethyl acrylate or butyl acrylate, other (meth)acrylic esters such as cyclohexyl methacrylate, isobornyl methacrylate, phenyl methacrylate and benzyl methacrylate, an aromatic vinyl compound such as styrene,  $\alpha$ -methylstyrene, chlorostyrene, other styrene

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derivatives or vinyl toluene, a vinyl cyanide compound such as acrylonitrile or methacrylonitrile, a halogen-containing vinyl compound such as vinyl chloride or vinylidene chloride, vinyl acetate, an  $\alpha,\beta$ -unsaturated carboxylic acid such as (meth)acrylic acid or crotonic acid,  
5 an olefin such as ethylene or propylene, a maleimide compound such as an N-alkylmaleimide, and the like. In particular, as a vinyl monomer to be polymerized in the presence of rubbery polymer particles is preferably used a monomer mixture of 50 to 100 % of a (meth)acrylic ester and 50 to 0 % of other copolymerizable monomer, especially a monomer mixture  
10 of 60 to 100 % of an alkyl methacrylate having a C<sub>1</sub> to C<sub>4</sub> alkyl group and 40 to 0 % of an alkyl acrylate and/or other copolymerizable monomer.

The polymerization for the multi-layered polymer is conducted by emulsion polymerization, suspension polymerization, bulk polymerization, solution polymerization and the like. Emulsion  
15 polymerization method is preferred from the viewpoint that control of polymer structure is easy.

As an impact modifier having a multilayer structure are preferably used a two-layered polymer obtained by polymerizing 80 to 15 parts, preferably 50 to 15 parts, more preferably 40 to 20 parts, of a graft  
20 monomer mixture of 50 to 100 %, preferably 60 to 95 %, of a (meth)acrylic ester and 50 to 0 %, preferably 40 to 5 %, of other copolymerizable monomer in the presence of 20 to 85 parts, preferably 50 to 85 parts, more preferably 60 to 80 parts, of a crosslinked acrylic rubber (the total of the rubber and the monomer mixture being 100  
25 parts); and a three-layered polymer obtained by polymerizing 10 to 60 parts of a graft monomer mixture of 50 to 100 %, preferably 60 to 95 %, of a (meth)acrylic ester and 50 to 0 %, preferably 40 to 5 %, of other

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copolymerizable monomer in the presence of a crosslinked acrylic rubber having a two layer structure obtained by polymerizing 30 to 60 parts of a monomer mixture of 50 to 99.9 % of an alkyl acrylate having a C<sub>4</sub> to C<sub>8</sub> alkyl group, 50 to 0 % of other copolymerizable monomer and 5 0.1 to 5 % of a crosslinking monomer in the presence of 10 to 40 parts of a hard polymer which forms a hard core (the total of the core layer, the rubber layer and the graft layer being 100 parts). As the other copolymerizable monomer in the graft monomer mixture are used vinyl monomers as mentioned above copolymerizable with the (meth)acrylic 10 esters.

The methyl methacrylate polymer mentioned above is preferably a combination of at least two polymers having a different molecular weight. That is to say, there is suitably used a mixture of 10 to 95 %, preferably 30 to 80 %, of a methyl methacrylate polymer having 15 a molecular weight of less than 500,000 and 5 to 90 %, preferably 20 to 70 %, of a methyl methacrylate polymer having a molecular weight of not less than 500,000. The molecular weight as used herein means a weight average molecular weight measured by GPC and calculated based on polystyrene having known molecular weights. The gloss lowering 20 mechanisms by the methyl methacrylate polymer having a molecular weight of not less than 500,000 are assumed that one is to provide a resin with viscosity and elasticity and the other is to make the surface of a capstock rough since it does not completely disperse into the methyl methacrylate polymer having a molecular weight of less than 500,000 25 and, as a result, is present in a size of several micrometers.

The resin composition of the present invention for extrusion into capstock comprises 0 to 70 parts, preferably 20 to 60 parts, of the

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above-mentioned methyl methacrylate polymer and 100 to 30 parts, preferably 80 to 40 parts, of the above-mentioned impact modifier having a multilayer structure. The composition comprising 20 to 60 parts of the methyl methacrylate polymer and 80 to 40 parts of the  
5 impact modifier having a multilayer structure is preferable from the viewpoint of a balance between the impact resistance and the processability. The resin composition of the present invention is characterized by its fluidity, and it is important that the composition has an MFI (melt flow index) of not more than 0.35 g/10 minutes measured  
10 according to ASTM D-1238 at 230°C and a load of 3.8 kg. The MFI of the composition is preferably from 0.01 to 0.30 g/10 minutes, more preferably from 0.03 to 0.20 g/10 minutes. If the MFI is more than 0.35 g/10 minutes, a low gloss capstock is hard to be obtained. From the viewpoint of processability, it is preferable that the MFI is at least 0.01  
15 g/10 minutes.

The process for preparing the acrylic resin composition of the present invention is not particularly limited, and the composition is obtained by mixing the methyl methacrylate polymer and the multi-layered impact modifier in a usual manner. The methyl methacrylate  
20 polymer and the multi-layered impact modifier may be prepared together by carrying out a graft polymerization to form a free polymer corresponding to the methyl methacrylate polymer.

The composition of the present invention may contain usual additives such as antioxidant, light stabilizer, lubricant, pigment, filler  
25 and the like, as occasion demands.

The acrylic resin composition of the present invention is useful as a capstock for moldings of various thermoplastic resins inferior

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in weatherability. The capstock can be formed on a thermoplastic resin substrate according to a known method, for instance, by co-extruding the composition of the present invention with a thermoplastic resin using a multi-manifold die.

5       The structure of and molding method using the multi-manifold die are as follows: A capstock resin and a substrate resin are separately introduced into respective dies and formed into sheets, and the sheets are laminated just before the outlets of the dies to give a laminated sheet. As another popular processing method is known a  
10      feed block die method wherein resins are stacked before entering a die and formed together into a sheet in the die. In case that the substrate and the capstock have different rheology characteristics, sheets having a uniform thickness cannot be obtained by the use of feed block die. In particular, in case that the viscosity of capstock resin is very high as in  
15      the present invention, good siding panels cannot be obtained unless a multi-manifold die is used.

          Siding panels having excellent weatherability, impact resistance and processability and a low gloss can be obtained by using the acrylic resin composition of the present invention as a capstock.

20       Various thermoplastic resins such as vinyl chloride resins and ABS resins are used as a resin of the substrate for the capstock. Vinyl chloride resins are particularly preferred from the viewpoints of processability and weatherability.

25       The present invention is more specifically explained by means of the following Examples and Comparative Example. It is to be understood that the present invention is not limited to these Examples.

EXAMPLE 1

Preparation of Impact Modifier having Three Layer Structure

(a) Polymerization for innermost layer

A glass reactor was charged with a mixture having the  
5 following composition. After elevating the temperature to 80°C with  
stirring in a nitrogen stream, 25 % of a liquid mixture of innermost layer  
components comprising 25 parts of methyl methacrylate, 0.1 part of allyl  
methacrylate and 0.1 part of t-butyl hydroperoxide was added all at once  
to the reactor, and the polymerization was carried out for 45 minutes.

10

Mixture	part
Deionized water	220
Boric acid	0.3
Sodium carbonate	0.03
N-Lauroylsarcosine sodium salt	0.09
Formaldehyde sodium sulfoxylate	0.09
Disodium ethylenediaminetetraacetate	0.006
Ferrous sulfate heptahydrate	0.002

Subsequently, the remaining 75 % of the mixture was  
continuously added to the reactor over 1 hour. After the completion of  
the addition, the reaction system was kept at 80°C for 2 hours to  
15 complete the polymerization. During this period, 0.2 part of N-  
lauroylsarcosine sodium salt was added. The polymer particles in the  
obtained latex of an innermost layer crosslinked methacrylic polymer  
had an average particle size of 1,600 Å (measured using light scattering  
at a wavelength of 546 nm). The polymerization conversion [(amount of  
20 polymer produced/amount of monomer charged) × 100] was 98 %.

(b) Polymerization for rubbery polymer

After adding 0.1 part of potassium persulfate to the crosslinked methacrylic polymer latex obtained in (a) which was kept at 80°C in a nitrogen stream, a monomer mixture of 41 parts of n-butyl acrylate, 9 parts of styrene and 1 part of allyl methacrylate was continuously added to the latex over 5 hours. During this period, potassium oleate was added three times in an amount of 0.1 part in total. After the completion of the addition of the monomer mixture, 0.05 part of potassium persulfate was further added and the reaction system was 10 kept for 2 hours to complete the polymerization. The obtained polymer had an average particle size of 2,300 Å, and the polymerization conversion was 99 %.

(c) Polymerization for outermost layer

The rubbery polymer latex obtained in (b) was kept at 80°C. 15 After adding 0.02 part of potassium persulfate thereto, a monomer mixture of 24 parts of methyl methacrylate, 1 part of n-butyl acrylate and 0.1 part of t-dodecylmercaptan was continuously added to the latex over 1 hour. After the completion of the addition of the monomer mixture, the reaction system was further kept for 1 hour to give a latex of 20 a multilayer graft copolymer. The multilayer graft copolymer in the latex had an average particle size of 2,530 Å, and the polymerization conversion was 99 %. The obtained multilayer graft copolymer latex was subjected to salting out for coagulation, heat treatment and drying in a known manner to give a white powder of the multilayer graft 25 copolymer.

Preparation of Resin Composition

To 70 parts of the obtained impact modifier and 30 parts of a

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methyl methacrylate copolymer composed of methyl methacrylate as a main component (methacrylic resin "Acrylite M-30" made by CYRO Corp. having a molecular weight of 70,000) were added, based on 100 parts of the total of the impact modifier and the copolymer, 5 parts of titanium oxide and 1 part of a ultraviolet absorber (Tinuvin-P made by Ciba Specialty Chemicals K.K. Japan). The resulting mixture was kneaded and pelletized using a twin screw extruder. The MFI of the obtained composition was measured at 230°C under a load of 3.8 kg according to ASTM D-1238.

10 Preparation of Siding Sheet

For the preparation of a substrate was used a composition comprising 100 parts of polyvinyl chloride (S-1001 made by Kaneka Corporation), 1 part of a stabilizer (MARK-1900 made by WITCO Corporation), 1 part of calcium stearate, 1 part of paraffin wax, 1 part of titanium oxide, 10 parts of calcium carbonate and 10 parts of an impact modifier (FM-31 made by Kaneka Corporation). An extruder KMD-130 made by Kraus Maffai was used for the extrusion of the substrate, an extruder KMD-60 made by Kraus Maffai was used for the extrusion of a capstock, and a laminate sheet was obtained by using a dual manifold die. The thickness of the substrate was adjusted to 0.8 mm, and the thickness of the capstock was adjusted to 0.2 mm.

Using the obtained sample, a Gardner impact strength (G.I., unit: inch·lb/mil) was measured at 23°C according to ASTM D4226-93. The gloss at 75° was also measured. The results are shown in Table 1.

EXAMPLE 2

Preparation of Impact Modifier Having Two Layer Structure

## (a) Preparation of rubbery polymer

A glass reactor was charged with a mixture having the following composition. After elevating the temperature to 50°C with stirring in a nitrogen stream, a monomer mixture comprising 100 parts of n-butyl acrylate, 1 part of allyl methacrylate and 0.1 part of cumene hydroperoxide was added dropwise to the reactor over 4 hours. Simultaneously with the addition of the monomer mixture, 2 parts of a 5 % aqueous solution of potassium stearate was continuously added over 4 hours. After the completion of the addition, the reaction system was further stirred for 5 hours to complete the polymerization. The polymerization conversion was 97 %, and the average particle size of the obtained polymer was 700 Å.

Mixture	part
Deionized water	250
Potassium stearate	0.5
Formaldehyde sodium sulfoxylate	0.2
Disodium ethylenediaminetetraacetate	0.01
Ferrous sulfate heptahydrate	0.005

## (b) Preparation of outer layer

A glass reactor was charged with 75 parts of the crosslinked rubber polymer latex obtained in (a), 0.05 part of formaldehyde sodium sulfoxylate, 0.01 part of disodium ethylenediaminetetraacetate and 0.005 part of ferrous sulfate heptahydrate. The aqueous dispersion was stirred in a nitrogen stream at 50°C. To the reactor were then continuously added over 1 hour 20 parts of methyl methacrylate and 5

parts of butyl methacrylate as graft monomer components and 0.05 part of cumene hydroperoxide as a polymerization initiator. After the completion of the addition, 0.01 part of cumene hydroperoxide was added and the reaction system was further stirred for 2 hours to 5 complete the polymerization. The polymerization conversion was 99.8 %. The powdery polymer was obtained from the resulting latex according to the procedure in the preparation of impact modifier in Example 1.

#### Preparation of Resin Composition

10 To 70 parts of the obtained impact modifier and 30 parts of a methyl methacrylate copolymer composed of methyl methacrylate as a main component (Acrylite M-30) were added, based on 100 parts of the total of the impact modifier and the copolymer, 5 parts of titanium oxide and 1 part of a ultraviolet absorber (Tinuvin-P). The resulting mixture 15 was kneaded and pelletized using a twin screw extruder.

#### Preparation of Siding Sheet

A laminate sheet was prepared in the same manner as in Example 1. The results of evaluation of the physical properties of this siding laminate sheet are shown in Table 1.

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### EXAMPLE 3

Preparation of methyl methacrylate copolymer having a molecular weight of not less than 500,000

25 A reactor equipped with a stirrer was charged with 200 parts of water, 1 part of sodium dioctylsuccinate and 0.2 part of potassium persulfate. After purging oxygen in water and the space of the reactor by passing nitrogen, the content was heated to 65°C with stirring. To

the reactor was then added over 4 hours a monomer mixture of 60 parts of methyl methacrylate, 15 parts of n-butyl methacrylate and 15 parts of n-butyl acrylate, and was further stirred with heating for 1 hour to complete the polymerization. A monomer mixture of 5 parts of n-butyl 5 methacrylate and 5 parts of n-butyl acrylate was then added over 1 hour, and the content was kept at 65°C for 1.5 hours and then allowed to stand to cool. The polymerization conversion was 99.2 %. The obtained polymer had an average particle size of 650 Å. The obtained copolymer latex was subjected to salting out for coagulation, heat 10 treatment and drying in a known manner to give a white powder of the copolymer. The molecular weight of this copolymer was 1,200,000.

A resin composition was prepared in the same manner as in Example 1 except that there were used 35 parts of the impact modifier obtained in Example 1, 30 parts of the impact modifier obtained in 15 Example 2, 10 parts of the above methyl methacrylate copolymer which had a molecular weight of not less than 500,000, and 25 parts of a methyl methacrylate copolymer having a molecular weight of 70,000 (Acrylite M-30). Using the composition as a capstock, a siding sheet was prepared by conducting the extrusion in the same manner as 20 Example 1 and the physical properties thereof were evaluated. The results are shown in Table 1.

#### EXAMPLE 4

A resin composition was prepared in the same manner as in 25 Example 1 except that there were used 30 parts of the impact modifier obtained in Example 1, 30 parts of the impact modifier obtained in Example 2, 15 parts of the methyl methacrylate copolymer obtained in

Example 3 which had a molecular weight of not less than 500,000, and 25 parts of a methyl methacrylate copolymer having a molecular weight of 70,000 (Acrylite M-30). Using the composition as a capstock, a siding sheet was prepared by conducting the extrusion in the same manner as Example 1 and the physical properties thereof were evaluated. 5 The results are shown in Table 1.

#### COMPARATIVE EXAMPLE 1

A siding sheet was prepared in the same manner as Example 10 1 by using 45 parts of the impact modifier obtained in Example 2 and 55 parts of a methyl methacrylate copolymer having a molecular weight of 70,000 (Acrylite M-30) without using a methyl methacrylate copolymer having a molecular weight of not less than 500,000. The MFI of the resin composition was 1.9. The results of evaluation are shown in 15 Table 1.

Table 1

	Ex. 1	Ex. 2	Ex. 3	Ex. 4	Com. Ex. 1
MFI	0.09	0.03	0.05	0.03	1.9
Gloss	59	57	27	19	73
G.I.	1.3	2.0	1.8	1.6	0.7